SOIL CONSERVATION

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ECONOMIC CONSEQUENCE OF CONSERVATION

By S. W. ATKINS[1]

THE adoption of recommended soil and water conservation measures by farmers often involves adjustments in the internal organization and operation of farms. That conservation measures are effective in the control of erosion is commonly accepted. There remains, however, the question of the probable effects on the immediate and future farm income.[2] The question is answered in this article insofar as it relates to one farm.

Howard Cooke's farm is located in the northeastern Piedmont of North Carolina. It is typical of the two-mule tobacco-cotton farms of that section. Mr. Cooke was one of the first farmers in the Cedar Creek demonstration area to inaugurate a cooperative conservation program when that project area was established in October 1935. The farm was in a badly run-down condition when he purchased it at a court sale in 1932. Sheet erosion had taken from 50 to 75 percent of the topsoil on all crop land. Gullies were active on a part of the cultivated area and on part of the woodland.

Mr. Cooke had made considerable progress in restoring the farm to its normal producing capacity prior to the establishment of the Soil Conservation Service program in 1936. At that time some idle crop land had been restored to the cultivated area, a small acreage of summer legumes was being grown for soil improvement and an attempt was being made to check erosion by mechanical means. However, no systematic crop rotation had been established; practically no winter cover crops were being grown; and the water disposal system was inadequate to control soil erosion. No permanent improved pasture was available (figure 1). Livestock was kept only for farm and home use.

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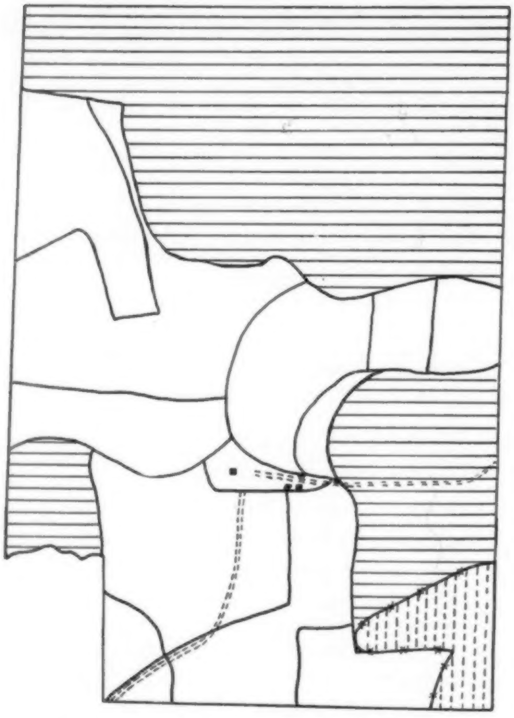
[2] The Department of Agricultural Economics of the North Carolina Agricultural Experiment Station, the Soil Conservation Service, and the Bureau of Agricultural Economics of the U. S. Department of Agriculture are cooperating agencies in a State-wide project to determine economic consequences of planned programs of the Soil Conservation Service.

In general the conservation plan for the farm consists of mechanical erosion control measures and adjustments in major land uses and in the cropping system. Some changes in livestock production are anticipated as a result of the changes in the kind and amount of feed produced under the new farm organization. The plan provides for mechanical erosion-control measures consisting of terraces and terrace outlets on all crop land; contour furrowing of the permanent pasture land, and contour tillage of all cultivated crops; and strip cropping on approximately half the crop land (figure 2).

One of the most significant proposed changes in land use is the shift of 11 acres of idle crop land to permanent pasture and to the cultivated crop area. The productive area of the farm in terms of crops and pasture is increased 20 percent by this change in land use.

The planned cropping system includes the establishment of systematic crop rotations, expansion of the acreage of winter cover crops, increase in the acreage of legumes for soil improvement, and the substitution of annual lespedeza for cowpeas and soybeans for hay and seed (table 1). Two major crop rotations are proposed—a 2-year rotation of flue-cured tobacco and rye, and a 4-year rotation of corn and/or cotton, oats, and lespedeza, with cowpeas interplanted in the corn. The latter rotation will be practiced principally on the strip-cropped area. A 2-year rotation of oats double-cropped with crotalaria, and corn interplanted with crotalaria, is planned for one field until normal productivity is restored. This field will then be included in



Field boundaries — Farm road
Woodland — Wood-brush pasture

Figure 1. Farm Layout on a Tobacco-Cotton Farm in North Carolina Before Replanned for Soil and Water Conservation

the 4-year rotation. No reduction in the acreage of tobacco is proposed. The planned reductions in the acreages of corn and cotton are not significant. Two acres of permanent hay will be introduced into the cropping system by the construction of meadow strips or grassed waterways. This device thus serves a dual purpose—as a source of hay and as protected terrace outlets.

No change in the livestock system is proposed except adjustment resulting directly from changes in land use and in the cropping system, namely, expansion of the hog enterprise and the addition of a few young cattle for grazing.

As was expected, the operation of this conservation program is bringing about many changes in the physical and economic conditions of the farm. Abundant evidence is available of physical conservation of the soil; gullies have disappeared, and sheet erosion has been reduced to a minimum. Economic effects to date are somewhat obscured by certain physical and economic factors affecting income and having no relation to the conservation program. Furthermore, sufficient time has not elapsed for the full effects of the program to be reflected in net farm income. Therefore, it is necessary that we analyze the probable economic consequences while holding constant such variable factors as prices paid for factors of production and prices received for products sold.

Crop and livestock production, which are expected to increase in the aggregate under the conservation

TABLE 1.—*Land use and crop production: Original system and soil conserving plan on a tobacco-cotton farm, Franklin County, N. C.*

Land use	Number of acres		Yield per acre		Total production	
	Original system	Soil conserving plan	Original system	Soil conserving plan	Original system	Soil conserving plan
Row crops:	*Acres*	*Acres*				
Tobacco	8.0	8.0	Lb 1,000	1,000	8,000	8,000
Cotton	4.0	3.6	Lb. (lint) .. 325	350	1,300	1,260
Corn	9.0	8.6	Bu 21	30	190	258
Other	2.0	1.2	......	......	......	......
Total row crops	23.0	21.4	......	......	......	......
Small grain:						
Oats	2.0	6.5	Bu 15	25	30	160
Rye	......	8.0	Bu	10	......	80
Hay:						
Cowpea-soybeans	7.0	......	Tons 1.0	......	7.0	......
Lespedeza	......	4.5	Tons	1.0	......	4.5
Meadow strip	......	2.0	Tons	1.0	......	2.0
Total hay	7.0	6.5	Tons	......	7.0	6.5
Cowpeas alone (seed)	5.0	......	Bu 8	......	40	......
Cowpeas intertilled	......	7.9	Bu	2	......	16
Lespedeza (seed)	4.0	6.3	Lb	250	......	1,575
Crotalaria	......	1.5	......	......	......	......
Total acres in crops	41.0	58.1	......	......	......	......
Acres double-cropped and intertilled.	2.0	15.1	......	......	......	......
Crop land harvested	39.0	43.0	......	......	......	......
Idle crop land	11.0	......	......	......	......	......
Permanent pastures	......	7.0	......	......	......	......
Woods pasture	3.0	......	......	......	......	......
Other woods	47.0	50.0	......	......	......	......
Other land	1.0	1.0	......	......	......	......
Total operated	101.0	101.0	......	......	......	......

plan of farming, are important causal factors in the improved income over the previous system. The amount of concentrates produced for feed (corn and oats) is expected to increase approximately one-half in terms of corn equivalent. Increased production of corn is based entirely on anticipated increase in yields per acre (table 1).[3] In addition to the expansion of the acreage of oats, yields per acre are expected to increase because of increased productivity of the soil and because of the shift from spring oats to winter oats. Crops available for hay—lespedeza and permanent hay—are almost doubled in acreage. However, the acreage of lespedeza above normal requirements for feed is to be harvested for seed by combining, and the

[3] Future yield estimates are based in part on results of research on effects of cropping systems on yields at the North Carolina Experiment Station and results on this farm since 1935.

straw is to be left on the land for soil improvement. Rye for grain is a new enterprise. No change in tobacco production is proposed, and total cotton production is expected to be reduced about 5 percent.

Improved permanent pasture should provide grazing for at least four animal units for a minimum of 6 months each year, and an additional 2 or 3 months' pasture should be available for at least two animal units. In contrast, no pasture other than brush and broomsedge pasture was available under the previous farming system.

These proposed changes in feed crops and pasture are expected to result in adjustments in the kind and amount of livestock. The operator will expand the hog enterprise by adding a brood sow, and by increasing pork production from 500 pounds for home use to more than 2,000 pounds for home use and for market (table 2). This is made possible by anticipated increase in corn production and release of corn for hog feed made possible by the substitution of some oats and pasture for corn in the ration for work stock. To utilize surplus pasture, four yearling cattle will be grazed a minimum of 6 months. They are to be purchased in the early spring of each year. A net production of 800 pounds of beef is expected annually. The operator prefers this use of the surplus pasture to increasing the number of milk cows, mainly because of the lack of a convenient market for dairy products.

TABLE 2.—*Livestock and livestock production: Original system and soil conserving plan*

Item	Production		Number of head	
	Original system	Soil conserving plan	Original system	Soil conserving plan
Workstock..........number..	....	....	2	2
Cows..........gallons, milk..	450	700	1	1
Calves..........pounds, veal..	100	100	1	1
Other cattle..........pounds..	....	800	....	4
Sow..........number..	....	....	....	1
Other hogs..........pounds..	500	2, 250	2	10
Hens..........number..	....	....	20	20
Eggs..........dozens..	250	250	....	....

It is significant that soil conservation is accomplished under the new plan without any apparent unfavorable effect on long-time net income. While total expenditures are calculated to increase from $803 to $964 as a result of the operation of the conservation plan, cash farm income is expected to increase from $2,327 to $2,639. Thus, the added receipts are approximately double the additional expenses.

The calculated increase in gross farm income is the result for the most part of the proposed expansion of the hog and cattle enterprise. Cash receipts from these combined enterprises account for $221 of the aggregate increase of $302 (table 3). The cash income from two new crop enterprises, rye and lespedeza seed, amount to $140, but this increase is offset in part by reductions in income from cowpea seed, sweet potatoes, and cotton. While increased soil productivity resulting from conservation is reflected in farm income, as calculated, no attempt is made to estimate the value of a probable increase in productivity of the farm woodlot through improved forestry practices.

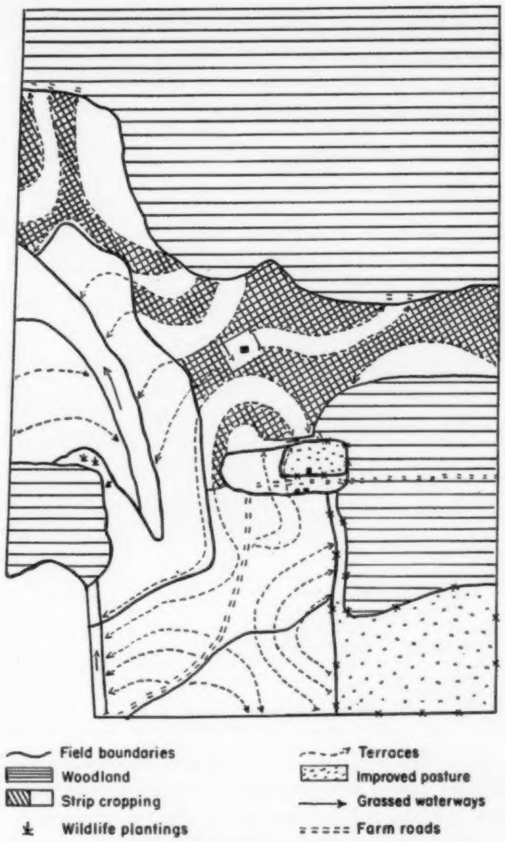


Figure 2. Farm Layout on a Tobacco-Cotton Farm in North Carolina Replanned for Soil and Water Conservation

An analysis of changes in farm expenses reveals an increase in such operating costs as fertilizer, harvesting small grain and seed, feed, and certain livestock expenses other than feed (table 3). Additional costs are incurred for such fixed items of expense as depreciation and interest on investment. The increase in depreciation is the result of the purchase of additional machinery and improvement of buildings and pasture fence. Interest on investment is increased as a result of the real-estate improvements, expansion of the

livestock enterprise, and costs incurred in the establishment of such conservation measures as improved pasture, grassed waterways, crop rotations, wildlife plantings, and gully control.[4]

TABLE 3.—*Financial summary: Original system and soil-conserving plan*

Receipts			Expenses		
Item	Original system	Soil-conserving plan	Item	Original system	Soil-conserving plan
	Dollars	*Dollars*		*Dollars*	*Dollars*
Crops:			Fertilizer	205	239
Tobacco	2,000	2,000	Harvesting grain and seed	35	63
Cotton	193	185	Seed	9	....
Rye	....	70	Ginning cotton	9	9
Lespedeza seed	....	70	Feed	23	34
Cowpeas	45	11	Other livestock expense	15	68
Other	51	32	Labor	350	350
Total crop receipts	2,289	2,368	Auto farm use	45	45
Livestock:			Taxes	47	47
Hogs	....	123	Depreciation	65	83
Cattle	8	98	Interest on improvements	....	26
Dairy product	....	25			
Poultry product	30	30	Grand total	803	964
Total livestock receipts	38	276			
Grand total	2,327	2,644			
Net return	1,524	1,680			
Increase in net returns: $156, or 10 percent.					

Farm labor is the major item of variable expense not changed by the new farm plan. While hours of labor used is estimated to decrease slightly under the conservation program, the reduction will not be reflected in cash expenditures for labor. More important than the decrease in hours of labor used is the more uniform distribution of labor expected under the proposed plan. This results primarily from a shift from summer legumes to lespedeza and to a small reduction in cultivated crops, chiefly cotton. Maintenance and/or improvements of conservation facilities and practices can be accomplished without conflict with normal peak labor loads. For example, maintenance of terraces, pasture, and grassed waterways can be done chiefly during the early spring months. Thinning the woodlot stand can be accomplished in conjunction with cutting wood for curing tobacco. This practice requires little labor in addition to that used originally for cutting curing wood.

Conservation measures established on this farm during the first 4 years conform very closely to the proposed plan. All terraces and terrace outlets have been constructed. Terrace outlets were protected by spreaders and shrubs where needed. Improved permanent pasture has been constructed and contour furrowed. Recommended maintenance practices are followed on terraces, terrace outlets, and permanent pasture. Contour tillage is practiced as originally recommended, except for a slight modification which was necessary to provide adequate drainage for tobacco. Strip cropping has been inaugurated on all land for which it was recommended. The principal modification made in the planned cropping system was the reduction in the acreage of corn and cotton below the acreage recommended. This change made possible a corresponding increase in the acreage of lespedeza for seed and for use in soil improvement. These adjustments in the cropping system were the result of relatively low prices of hogs and cotton and of the operator's desire to facilitate increase in the productivity of the soil. Increase of 50 percent or more in corn yields per acre to date indicate to some extent the success of this soil improvement program. The practice of harvesting small grain is lagging in part because of the operator's difficulty in getting a combine in the early years of the program.[5] Oats are used in part for hay, and some rye is left on the land to be followed by tobacco the second year. Pigs, except those for home use, are now being marketed as feeders instead of market hogs. The farm poultry enterprise has been expanded slightly, because of relatively low prices of hogs and the farmer's preference for further diversification of livestock.

The program "in action" is decidedly in the direction of soil and water conservation. While the goal has been exceeded in some phases of the program, the complete program as proposed should be attained, with minor adjustments, in another 4-year period. Observation is adequate to reveal its success in terms of physical conservation; up to the present the annual farm records show no decrease in actual net farm income, which can be attributed to the operation of the planned program.

The success of the program to date may be attributed in no small part to Mr. Cooke's recognition of the need for conservation and to his capacity for putting the recommended plan into operation. It should be recognized, however, that certain other factors, such as freedom from mortgage debt and the availability of a relatively large crop area, are contributing factors. Also, net farm income was adequate to provide funds necesssary for establishing the conservation program.

[4] Terraces were constructed by farm labor and power at very little or no cash cost. This item was thus excluded from the calculation.

[5] This difficulty does not exist now, as several combines are available in the area.

In the next issue: District Operation From a Supervisor's Standpoint, by F. S. Hurd.

1. *Virgil Stone home, rebuilt by conservation farming.*

2. *First came better land use, then the rebuilding of this home of Mr. and Mrs. I. L. Pool.*

3. *From a sounder agriculture came the funds with which to rebuild the Methodist Church building and pay for a new Sunday-school room.*

4. *An artist's sketch of Carmel Baptist Church, rebuilt and reinvigorated as soils are saved.*

Churches prosper as Conservation comes to the land

By Charles G. Webb[1]

WISE land use has a moral and spiritual value. Soil conservation gives new life to rural communities and their churches.

Reliable economic surveys in demonstration projects already have indicated that conservation farming practices usually tend to increase farm income. But these surveys of material benefits do not include the intangible values of soil saving.

As an example of the economic benefits to be obtained from conservation farming practices, the Duck Creek Demonstration Project of the Soil Conservation Service near Lindale, Smith County, Tex., is sometimes cited.

Since 1935, when the demonstration project was getting under way at Lindale, economic studies have been made on two groups of farms. One group received the assistance of the Soil Conservation Service in the establishment of conservation practices, and one group did not. The two sets of farms were as nearly similar as possible: alike as to size, soil types, topography, cropping systems, distance from markets, managerial ability of operators, and so forth. During the 5-year period ending 1939, the conservation farmers received an average of $2,406 in net farm income, while their neighbors, who continued to use the old methods, received only $1,360 each in net farm income. Here was a difference of $1,046 in favor of conservation farming in 5 years.

Have the churches in the Duck Creek watershed benefited, too?

For an answer to that question I talked with I. J. Hall, who has been treasurer of the Carmel Baptist Church in the watershed for 9 years, and with Miss Lillian Sharman, church clerk since 1931. And here is the story summarized:

In 1934 Carmel Baptist Church had no pastor, had 72 members, and received offerings of only $47. The church building, constructed in 1876 and last remodeled in 1908, was in a sad state of repair. In 1939 the church had a regular pastor, the Reverend Mr. A. W. Coltharp, had 104 members, and received offerings totaling $711.49. During 1939 the members spent $551.25, plus labor which they donated, to construct a new church building.

During that period from 1934 to 1939, the church

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membership had increased 44 percent and the offerings had increased approximately 1,400 percent.

This evaluation of the benefits the church received, based on members and offerings, does not tell the whole story any more than the economic surveys did.

What is more important is the attitude of the members. In the words of Mr. Hall:

"Before we obtained a regular minister and improved our building, some of our people were moving their memberships to town and some of them weren't going to church anywhere. Our people are now staying in their home community to worship.

"We pay our minister $10 a month. He preaches one week end each month—Saturday night, Sunday morning, and Sunday night. A few years ago it was hard to collect $10 to pay a minister, but now the people don't wait for you to ask them to help pay the preacher. They come around and ask to help."

As Miss Sharman expressed it:

"We could have done more for our church every year, even back in 1934, but we just didn't."

Why didn't the members of Carmel Baptist Church give greater support to their church? First, let's examine the condition of the land and the economic condition of the people in Duck Creek watershed in 1934; then let's consider briefly a few historical and Biblical references. Perhaps we can thus find the answer.

Conservation surveys of the farms in the Duck Creek watershed disclosed that in 1934 at least one-third of the original topsoil had been removed by erosion. Because only the topsoil can be farmed profitably, it naturally follows that the landowners in the watershed had lost one-third of their original capital investment in the land. The per acre production of the two principal cash crops was low; in 1934, the average lint cotton production on the 187 farms in the watershed was 113 pounds per acre and the average corn yield was 5.2 bushels per acre. These low yields were further evidence of the approaching depletion of soil resources. Low yields and low prices for farm products were reflected in the poor economic conditions. In 1934, the average net farm income on the 187 farms was $130. Fences, buildings, and equipment were run-down, and the farm work animals were old.

From time immemorial people have drifted from the church and its teachings when they no longer have the necessities of life. When the Israelites were hungry and in the wilderness, they pleaded to return to Egyptian slavery where at least they would be fed. In Exodus 16:2 we find this statement, "The whole congregation of the children of Israel murmured . . ."

History is filled with the records of civilizations which have fallen because of a demoralized agriculture. In Northern Africa and Syria, for example, there are ruins today of civilizations which were completely wiped out because the people permitted the soil to wash or blow away. And unproductive soil will support neither a people nor such institutions of civilization as churches and schools.

In contrast with the low farm income and low crop yields of 1934, consider the income and yields from the conservation-treated farms in 1939. Conservation farmers in 1939 had an average net farm income, including A. A. A. payments, of $490, nearly four times as great as the net farm income they had in 1934. Cotton yields on these farms in 1939 averaged 159.5 pounds of lint per acre and the corn production averaged 12.4 bushels per acre. Those figures represent an increase of more than 41 percent in the cotton yields and of more than 138 percent in the corn yields. The remainder of the increase in income as compared with 1934 was due to the increase in prices over the 5-year period brought about by general economic improvement and the price-supporting measures carried on by the Department of Agriculture. During the past 5 years of conservation farming, the cooperators of the Soil Conservation Service have averaged 155.8 pounds of lint cotton per acre and 11.5 bushels of corn per acre.

People whose lands are productive, whose income is sufficient to provide them with the necessities of life and who find hope and opportunity in their lands and their markets, are more able to support their churches, their schools, and their other community enterprises. There is a feeling of security and peace which comes to the man whose land pays him well for good stewardship. In the Bible it is said, "But they shall sit every man under his vine and under his fig tree; and none shall make them afraid."

"Material, social and religious prosperity usually go hand-in-hand," said the Reverend Mr. Coltharp, "and it's largely that way in the Carmel community. Our people now have more to do with. They have more hope, more security, and more opportunity, but they must work hard. It's a 6-day-a-week job. This land should have been protected 65 or 70 years ago, and our people have to work harder now because the land wasn't protected."

The conservation farmers of the Duck Creek watershed don't have any more topsoil than they had in 1934. But they are using wisely the topsoil remaining. They are protecting it from soil erosion. They are improving it by the use of proper crop rotations, which include legumes. If these farmers do not preserve and improve this land, if they are not good

stewards, they know that their children will have less opportunity to earn a living from the soil.

And the land has responded. In 1939, Mr. Hall said he harvested 35 bales of cotton from 33 acres, as compared with an average of one-third of a bale per acre before he began conservation farming. The improved pastures on his farm have enabled him to increase the number of cows from 3 in 1934 to 10, and there's grass enough in the pastures to carry 25 cows through the grazing season. Where formerly Mr. Hall's principal cash crop was cotton, he now has an added source of income from cattle. He estimated that he sells $150 worth of whole milk each year. Last spring he sold 4 cows at $35 each, and replaced them with young and better grade animals. He is growing all the feed needed for his livestock.

Farm homes throughout the Duck Creek watershed reflect the fact that better days have come to the community. Virgil Stone, I. L. Pool, and C. W. Flewellen have rebuilt old residences. The Stone residence, built by Mr. Stone's grandfather shortly after the War between the States, was so run down that Mr. and Mrs. Stone did not live on their farm until they were able to rebuild. New homes have been erected by Park York, R. W. Copeland, and S. H. Ferguson. W. O. Smith has put up a new tenant house, and J. R. Bowdoin has reroofed three tenant houses. There are new roofs, new paint, or both, on the residences of George Lake, Mr. Hall, B. A. Elliott, Mrs. M. F. Hall, W. T. Copeland, J. A. Johnson, Mrs. H. A. Bowdoin, and the late Miss Zelda Copeland.

Mr. Pool, a steward of the Methodist Church in the Duck Creek watershed, also cited improvements which had been made to his church. In 1936 the members spent $530 in rebuilding. In 1937 a $200 Sunday School room was built with the help of the Methodist Church's Board of Church Extension. The members contributed the labor.

"It's a good deal easier now to raise salaries and conference claims for our church than it was several years ago, but I don't think we can give all the credit to conservation farming or to A. A. A. loans and payments," Mr. Pool said.

"But we know what will happen if we permit our land to wash away," he continued. "Everyone will be forced to leave, because it is no longer possible to make a living. Naturally, that would mean the death of our rural community and our rural church."

Mr. Pool said he had seen many desirable land-use adjustments made in the watershed as a result of conservation farming.

"This county was cottoned to death and the land was washing away," he explained. "Most of the farmers couldn't start a crop each year until they had bought feed. Now our farmers are raising feed for their livestock."

A complete and coordinated conservation farming system, such as the cooperating farmers of the Duck Creek watershed established, provides for the treatment of every farm acre according to its needs and capabilities. Steep and severely eroded land which was neither safe nor profitable in cotton and corn was retired to grass or trees. Old pastures were improved to control erosion. Consequently, there is more forage available for livestock. The adoption of proper crop rotations has increased the production of feed crops.

Mr. Pool has been operating his 100-acre farm 42 years. Fields in which there were gullies 40 years ago have been protected from soil erosion, and today this land, which has been in cultivation since the War between the States, is producing profitable crops.

And such land—even 100 acres, the size of Mr. Pool's farm—means security and opportunity for a family. All of the nine children of Mr. and Mrs. Pool are high school graduates; seven also are college graduates, and one is now attending college.

Conservation farming is nothing less than obedience to the natural laws stated in the beginning by the Creator.

LOW-COUMARIN SWEETCLOVER

Sweetclover is one of the important legumes being used under certain conditions in soil conservation work. Abundant seeding, vigorous growth, the occurrence of nitrogen-fixing bacteria on its roots and its value in pastures are among its most important qualities. However, it is not palatable to stock that are unaccustomed to it, on account of the bitter taste arising from the coumarin it contains.

A low-coumarin strain of sweetclover has been licensed in Canada as the variety "Pioneer." It will be increased under contract in 1940–41. The development of this new strain is described by T. M. Stevenson and W. J. White of the Experimental Farms Service, Ottawa, Ontario, in Scientific Agriculture, Vol. XXI, September 1940, pp. 18–28. This strain of sweetclover has a coumarin content varying from zero to 0.05 percent and averages around 0.02 percent, which is about one-tenth as much as the average in unselected material.

FARMER EVALUATION OF CONSERVATION PRACTICES IN SOUTHERN PLAINS

By H. H. FINNELL [1] AND THEODORE A. NEUBAUER [2]

FARMERS are very good at choosing conservation practices according to needs and usefulness, when a complete program is offered them. This is one conclusion to be derived from a recent study of farmer evaluation and criticism of conservation practices in the Southern Great Plains Region. An analysis of the results of a survey made by the Soil Conservation Service shows that 88.6 percent of the farmer cooperators reported an increase in the value of their farms as a result of installing a conservation program; 80.4 percent reported a net increase in farm income as a result of practicing conservation; 95 percent expressed their intention of continuing the program after the expiration of their cooperative agreements; and 70.4 percent expressed the opinion that none of the practices recommended by the Service should be eliminated from the conservation program.

Questionnaires were mailed to 4,200 cooperating farmers and ranchers, some of whom had been cooperators with the Service for as long as 6 years. The summary of the 2,257 replies, in which practices were listed in the order of their value to the farmer, affords at least a preliminary evaluation based on practical experience. The popularity of the different conservation practices for the region as a whole may be appreciated by noting their general rank in the accompanying table. Contour farming, terracing and gully control, the three most valued practices, all have to do with the management and control of water on cropland, excepting only gully control practices as used in the grazing areas. It probably is significant that the next three ranking practices—grazing control, pasture furrowing and stock water ponds—all have to do with grazing land.

As would be expected, farmer opinion shows a tendency to conform to climatic and type-of-farming belts. The areas of the Southern Great Plains Region fall roughly into three rainfall belts, 12 to 18 inches, 18 to 24 inches, and 24 to 36 inches. The low-rainfall belt includes eastern New Mexico and eastern Colorado; the middle belt, the high plains of Texas and Oklahoma and the western half of Kansas; and the high-rainfall belt includes the eastern half of Kansas.

Value of conservation practices as reported by farmers in rainfall belts of Region 6, 1940

Practices	Total farmers reporting from Region 6	Reports from rainfall belt 24 to 36 inches	Reports from rainfall belt 18 to 24 inches	Reports from rainfall belt 12 to 18 inches
	Percent	*Percent*	*Percent*	*Percent*
Contour farming	74.6	76.1	83.9	56.7
Terracing	58.1	76.8	59.0	24.5
Gully control	49.4	80.7	23.8	38.5
Grazing control	43.3	42.2	34.9	59.6
Pasture furrowing	39.7	29.3	41.3	55.1
Stock water ponds	38.6	43.9	24.4	53.4
Cropping system	35.1	46.4	30.6	23.5
Water diversions	33.5	42.7	22.8	35.1
Tree planting	30.6	39.2	19.5	33.8
Strip cropping	29.9	24.0	36.5	28.3
Cover cropping	27.1	16.4	36.8	29.9
Wildlife development	14.7	17.8	10.6	16.2
Revegetation	13.8	12.8	11.9	18.5
Border plantings	11.5	7.7	18.3	6.6
Miscellaneous	3.6	3.3	4.5	3.2
Total number of reports received	2,257	857	839	561

The central belt contains most of the flat plains area of even topography. Both to the east and to the west lie belts of significantly more rolling topography, one with greater rainfall, the other with less. Considering the different combinations of land use and water relations to soil, it is to be expected that different practices would be more valuable in different areas.

The change of emphasis between rainfall belts is marked. The preferred six practices in the low-rainfall or western belt are grazing control, contour farming, pasture furrowing, stock water ponds, gully control and water diversions, in the order named. Contour farming, terracing, pasture furrowing, cover cropping, strip cropping, and grazing control are the conservation practices considered most valuable in the middle rainfall belt; while in the highest-rainfall belt they are gully control, terracing, contour farming, improved cropping systems, stock water ponds and water diversions, in the order named.

Terracing and improved cropping declined in importance in passing from wetter to drier areas. On the other hand, pasture furrowing steadily increased in importance toward the drier areas. All the other practices listed arranged themselves into two groups. Contour farming, strip cropping, cover cropping, and border plantings were of greater importance in the middle, or plains, belt than in the areas either to the east or west. Gully control, grazing control, stock

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water ponds, water diversions, tree planting, wildlife development, and revegetation were found to be of lesser importance in the middle belt than either to the east or west. Two practices owed their importance in the extreme eastern and western parts of the region to opposite conditions. Water diversions, for example, were important in the 24- to 36-inch rainfall belt mainly as a means of disposing of excess water threatening gully formation largely on crop land; whereas in the 12- to 18-inch rainfall belt water diversions were important for collecting surface water to be used for flood irrigation largely on range land. Nine other conservation practices were considered more important than water diversions in the middle rainfall belt.

Gully control work was rated as of first importance in the high-rainfall belt where much of the gully problem exists on cultivated land that has been used intensively for the production of high-value types of crops not naturally resistant to erosion. On the other hand, gully control received a relatively high rank in the low-rainfall belt, but here it is applied mainly on grazing land where the natural vegetation is so sparse that its effectiveness for erosion control is quickly reduced by overgrazing. Eight other conservation practices were considered more valuable than gully control in the middle rainfall belt.

It is significant that the majority of those practices showing an upward trend toward the middle of the region had to do with crop management—namely, strip cropping, cover cropping, and border plantings. Probably contour farming and terracing are found at the top of the list for the whole region because they are the practices most generally used with profit throughout the region.

The nearly two-thirds of the total area of the region being devoted to livestock production accounts for the relatively high rank of important grazing land practices. That the livestock industry in Region 6 is divided through the center by a great belt where crop farming interest predominates is shown by the fact that stock water ponds were highly valued by 44 percent of all cooperators in the eastern half of Kansas, 53 percent along the western side of the region, while only 24 percent mentioned them through the central portion of the region. The number of cooperators placing a high value on ponds in eastern Kansas is increased no doubt by the scarcity of ground water in some localities.

Other less universally applicable practices, appearing in the lower half of the group, such as water diversion, tree planting, strip cropping, cover cropping, wildlife development, revegetation and border plantings, are not necessarily less valuable than other practices, but apparently they are less frequently applicable and hence do not appear in all conservation plans. In fact, these data do not form a basis for evaluating the comparative merits of practices because the distribution of experience with all practices was not uniform among all farmers reporting. After all, very few if any of the practices are competitive with other practices; rather, each fits into certain conditions of need and operates with other practices to cross-brace the general structure of the conservation plan.

The applicability of conservation practices to the region as a whole appears to be affected mainly by two factors, water and grass. Water is a factor because of the need for it in relation to the land use and the possibilities of improving the efficiency of its utilization. Grass is a factor because of the predominance of grazing land use which exists partly because of limitation of use capabilities and partly because of incomplete land-use development.

Significant trends between rainfall belts, shown by the farmers' preference for different conservation practices, are consistent with existing land and land-use conditions. This indicates a discernment and acceptance of limiting factors by farmers.

"THE MAXIMUM EXERCISE OF INITIATIVE"

The soil conservation districts are local units of government, organized under State laws and answerable to the State legislatures. They operate, in most cases, over naturally bounded areas, and come into existence only in response to the petition and favorable referendum vote of the landowners and operators carrying on agricultural operations within their boundaries. In this way the necessary basis has been laid for the maximum exercise of initiative and responsibility by the farmers themselves.

The philosophy of democratic government revolves around the principle that the mass of the people is capable of governing. It is my conviction that a democracy, therefore, cannot be said to be succeeding unless the mass of the people participates in the affairs of government. Only their participation makes a democracy work. The distinguishing characteristic of the districts' legislation is that this principle is uppermost; these State laws place the responsibility for the management of a soil conservation program upon local folk.—*Claude R. Wickard, Secretary of Agriculture, in a statement dated September 21, 1940.*

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SAVING SOIL AND MAINTAINING INCOME

By DAVID H. WALTER[1]

SINCE most farmers are primarily interested in obtaining a living from their land, the cost of adopting erosion control practices and their effect upon net returns will likely determine the extent of cooperation. Although the greatest returns over a period of years may be most desirable, the farmer will place major importance upon current returns, especially in areas where the margin between receipts and expenses is very small. It is hoped that this analysis of more or less preliminary survey data will help in settling the question of farm income as related to the establishment of a soil conservation program.

The first project in Pennsylvania for demonstrating erosion control practices on privately owned land, under the direction of the Soil Conservation Service, was established late in 1934 in the Crooked Creek watershed of Indiana and Armstrong Counties. In an effort to determine the effects of this program upon land use, crop production, and especially upon income, detailed survey records were obtained for 106 farms for the years 1934, 1936, and 1938.[2] Forty-eight of these farms are now cooperating in the program, having entered into their agreements either in 1935 or early in 1936. The last survey, therefore, would include the data for either the third or fourth crop year under the planned agreement.

The data for the 3 years indicate that by the adoption of some of the soil conservation practices for this area, considering all costs, the average labor income was decreased in 1936 during the period of establishing that program, but in 1938 when the program was almost completed, the labor income was increased to a point higher than it would have been if the program had not been adopted. Can these gains be ascribed to the soil conservation program? Will they continue? Fortunately, the basic data for 1934 are available and this affords an opportunity to determine by future studies whether the advantage gained in income by 1938 on cooperating farms will be maintained, increased, or decreased.

These two groups of farms, cooperating and noncooperating, are very similar in respect to size, total investment, type of farm, location over the watershed area, percent of tenancy, and age of operator. In 1934 they were all classed as full-time farms, and during the period covered by this study not one change in ownership was reported.

Most of the land is on rolling to steep slopes. The soils are mostly shallow and relatively low in productivity even where little or no erosion has taken place. The relative productiveness of the land is about average for the State or slightly below. Survey data show that more than half of the original topsoil has been lost from the cleared land. A few of the local farmers had adopted a system of strip cropping for erosion control prior to 1934, but the common practice was to plant large fields to a single crop. In 1934, the average size of the 48 cooperating farms was 108 acres. Of this, 13 acres were in woods, 24 in permanent pasture, 52 in crops, and 19 acres in "other land" which was mostly idle cleared land. About 12 acres were used for clean tilled crops, 19 acres for small grain crops, and 19 acres for hay. The land use on noncooperating farms was similar to that on cooperating farms.

The soil conservation program, in general, calls for contour strip cropping, reforesting steep slopes and badly eroded land, protection of old woods from grazing, improvement of some hay and pasture land by the application of lime, seed, and fertilizer, an increase in the acreage of hay, a decrease in the acreage of grain and row crops, and certain structures, such as diversion ditches and contour furrows, for the control of excess water.

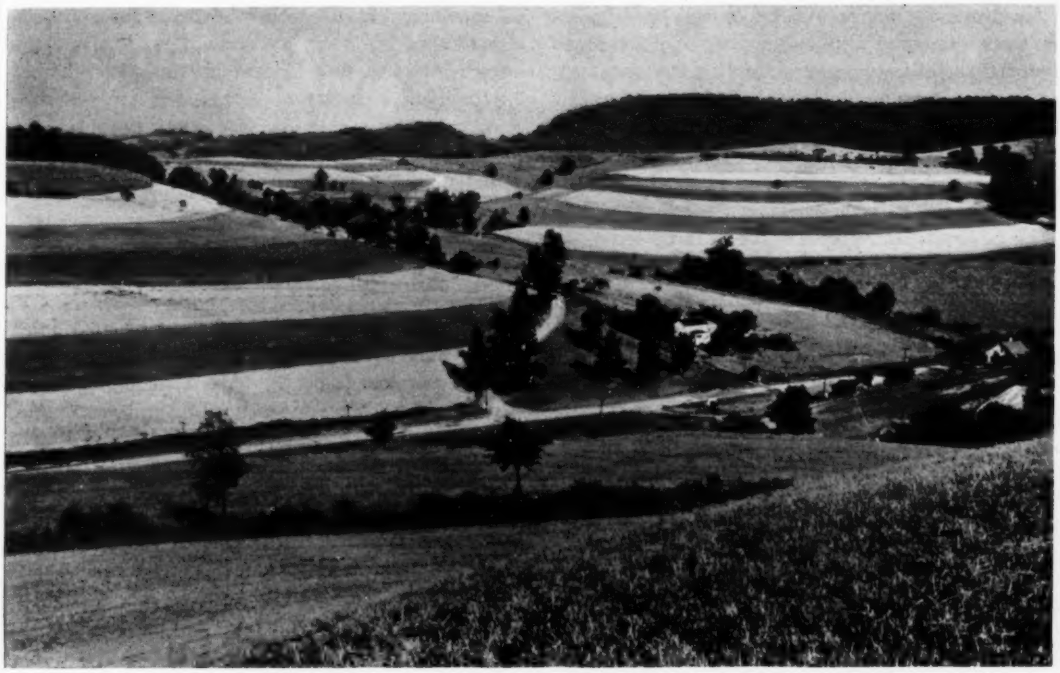
Land-Use Changes

Practically every one of the 48 cooperating farms included in the study has followed rather closely the major changes as planned in the farm layout and field arrangement. Acreage changes were not as great as might be expected. Both cooperators and noncooperators decreased their crop area by 2.7 acres and increased permanent pasture by 5 acres. The reforestation program was responsible for an increase of 5 acres in young plantings on the cooperators' farms.

Although the total crop acres on noncooperating farms was reduced, the proportion of the total crop land area in hay, and in grain and row crops, remained about the same. A decided shift to a higher proportion in hay and a smaller proportion in grain and row crops was reported on cooperating farms.

[1] Project supervisor, economic research, Northeastern Region, Soil Conservation Service, State College, Pa.

[2] Cooperative research project in the economics of soil conservation between the Soil Conservation Service and Bureau of Agricultural Economics of the United States Department of Agriculture, and the Department of Agricultural Economics of the Pennsylvania State College.



Contour strip cropping on the farm of G. Stephen Edwards, Indiana County, Pa.

As planned in the agreements, the acreage of grain and row crops for 1938 was 3.6 acres per farm less than in 1934.

Hay acreage on the cooperating farms was to be increased 10.2 acres per farm by 1938, but the survey data showed only a 2.2 acreage increase. Low prices, failure of their grass seeding, and no use for the additional hay, were reasons given by some of the operators regarding failure to reach the planned acreage. Another reason was that much of the hay land planned for three or more years without reseeding was of very low quality after the second year, and on a number of farms it was not harvested.

Average crop yields on both cooperating and noncooperating farms were lower in 1938 than in 1934, but yields on cooperators' farms decreased only 1 percent compared to a 6-percent decrease in the other group. A change in yields over such a short period of time can hardly be attributed to saving or losing soil. Three factors probably were responsible for the relatively better yields on cooperators' farms. First was the probable saving of moisture by adoption of contour strip cropping; the soils are shallow and plant growth is quickly affected during dry periods. Second is the increased amounts of lime, manure and fertilizer used per acre of crops. Third, and probably the most important, was the shift in land use, such as using the poorest crop land for pasture or reforestation.

An important consideration in planning land use and crop acreage changes is the effect upon feed production, especially in an area such as this where practically all crops are fed. Grain production was reduced slightly on cooperators' farms, but increased a little on noncooperators' farms. Roughage production in 1938 increased over 1934 figures for both groups, but increased considerably more on cooperating farms. On a percentage basis, the cooperators increased production of total digestible nutrients 9 percent as compared with an increase of 7 percent for the noncooperators. These figures show that feed production was maintained after desirable shifts had been made in land use, although some shift to more roughage and less grain was involved.

Most pastures are idle or abandoned crop fields that have not been limed or fertilized since the last crop was grown. At least part of the pasture land on all of the 48 cooperating farms received treatment with lime and fertilizer since 1934. In addition, an increase in acreage and favorable shifts in land use have resulted in considerably more available pasture feed per farm. Very little change in pasture treatment has taken place during this time on the noncooperating farms.

Changes in the number of livestock were very similar for both groups of farms. Numbers of dairy cows declined slightly, work animals and poultry remained about the same. Between April 1, 1938, and April 1, 1939, numbers of young cattle doubled on cooperators' farms and increased 50 percent on noncooperators' farms.

The increase in young stock is an indication that these farmers are utilizing, at least in part, the increased hay production and better pastures. Most dairymen in this section raise their own replacements for the herd. If present hay and pasture production are maintained or increased, the trend toward more dairying will be encouraged, especially if price relationships are favorable.

One of the most significant changes on cooperating farms has been the increase in milk production per cow. Twenty-one farms that sold whole milk continuously from 1934 to 1938 showed an average increase per cow of 1,000 pounds, or a change from 4,500 pounds to 5,500 pounds (table 1). Part of this change may be because of replacements by better cows and feeding about 175 pounds more of purchased concentrates per cow in 1938 than in 1934 on these 21 farms, but much of it is probably due to more and higher quality hay and pasture. Production per cow of noncooperating farms remained practically the same.

TABLE 1.—*Milk production per cow in 1934 and in 1938 for farms selling whole milk*

Item	21 cooperating farms		15 noncooperating farms	
	1934	1938	1934	1938
Number of cows	8.8	8.4	9.4	8.8
Milk production per cow ... cwt.	45	55	49	49
Price of milk per cwt ... dollars	2.18	2.17	2.25	2.26
Cattle increase and net sales per cattle unit ... dollars	10	18	11	14
Labor income ... do.	60	334	361	211

Cost of Labor

Labor costs and the efficiency of man labor on the two groups of farms indicate that the cooperating farmers have not experienced any increase in labor costs because of the program, but instead have lowered costs and improved efficiency. However, in this area where most farm businesses are small with a large local fluctuation in industrial employment, primarily in the soft coal mines, a comparison of labor costs is not a satisfactory measuring stick of the change in efficiency resulting from the new farm layout. Members of the family are often used inefficiently on the farm between periods of employment elsewhere.

Assuming no change in labor efficiency and using established standards for growing crops and caring for livestock, it took 28 days less time to do the productive work on the cooperating farms in 1938 than in 1934. This decrease was made possible by a decrease in total crop acres, a shift to more hay and less grain, and a slight decrease in number of cows.

Farm Returns

A comparison of receipts on the two groups of farms shows that *gross income* was about the same for both groups in 1934 but that the cooperators increased their gross income from 1934 to 1938 by $181 more than the noncooperators (table 2). About two-thirds of this was from the dairy and resulted from increased production per cow and increased numbers of young cattle. The increase in income from sale and appreciation of dairy cattle, however, was more than the increase from the sale of dairy products. Both groups showed a decline in income from crops, chiefly because of a reduction in potato acreage and a lower price for hay. Cooperators received larger A. A. A. payments and made a greater increase in nonfarm income, which was mostly from day labor off the farm.

Gross expenses increased slightly more on noncooperating than cooperating farms from 1934 to 1938. Cooperators reported a decrease of $20 for labor and an increase of $16 for feed and $68 for lime and fertilizer per farm, while noncooperators reported increases of $19 for labor, $45 for feed, and $30 for lime and fertilizer. Very little difference was found in the other expense items.

Labor incomes on 48 cooperating farms increased $128 from 1934 to 1938, while on the 58 noncooperating farms labor incomes increased only $9. The net increase in labor income in favor of the cooperators was $119. It must be remembered, however, that the data presented thus far have shown a comparison between 1938, a year after the program had become quite well established, and 1934, a year when none of the farmers was cooperating in the program. A very important consideration is the effect on incomes during the first few years should the farmer adopt the program without assistance in materials and labor.

Between 1934 and 1936, labor incomes on cooperating farms increased $48, while the labor incomes on noncooperating farms increased $131—an advantage for the noncooperating farms of $83 after deducting all contributions ($142 per farm) from the Government (table 3).

When grouped by type of farm, the cooperators in all cases averaged a greater increase in labor income from

Table 2.—*Receipts in 1934, and change from 1934 to 1938 on 48 farms cooperating and 58 farms not cooperating with the Soil Conservation Service*

Source of receipt	Receipts per farm, 1934		Change in receipts, 1934 to 1938	
	48 cooperating	58 noncooperating	48 cooperating	58 noncooperating
	Dollars	*Dollars*	*Dollars*	*Dollars*
Dairy	595	501	146	32
Poultry	202	253	95	92
All other livestock	102	92	23	23
Crops	111	130	−19	−39
Miscellaneous farm	38	49	35	34
Miscellaneous nonfarm	52	48	7	−12
Agricultural conservation payments	0	2	43	19
Total	1,100	1,075	330	149

Table 3.—*Change in labor incomes between 1934 and 1936 and between 1934 and 1938 on 48 farms cooperating and on 58 farms not cooperating with the Soil Conservation Service* [1]

Farms	Labor income			Change	
	1934	1936	1938	1934 to 1936	1934 to 1938
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Cooperating	−132	−84	−4	48	128
Noncooperating	−38	93	−29	131	9

[1] Cost of Government contributions from the 2 conservation programs is charged as an expense in these calculations.

placed on a more permanent productive basis by a land-use plan that will reduce soil losses.

Some of the changes on cooperating farms over the 4-year period can be attributed directly to the program. On the other hand, further study will be necessary to determine the cause of others and whether they are of a temporary or of a permanent nature. The significant changes on the average cooperating farm are those listed below:

1. An increase in hay acreage and a decrease in cultivated and small grain crops.
2. An increase of 5 acres in young forest plantings.
3. A higher percentage of legume hay, particularly alfalfa.
4. Use of more lime and fertilizer, especially on pasture.
5. A slight decrease in total production of grain feed and a considerable increase in total production of roughage.
6. Increase in number of young cattle.
7. Increase in pounds of milk produced per cow.
8. Increase in receipts from dairy cattle and dairy products.
9. Increase in lime and fertilizer costs, but a decrease in labor costs.

Table 4.—*Labor income on 102 farms in 1934 and in 1938 by type of farm and by cooperation with the Soil Conservation Service*

Item	Dairy		Poultry		General	
	Cooperating	Noncooperating	Cooperating	Noncooperating	Cooperating	Noncooperating
Number of farms	29	27	3	8	15	20
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Agricultural conservation program payments, 1934	46	20	21	19	44	24
Cost of Soil Conservation Service program chargeable to 1938	34	0	30	0	30	0
Labor income in 1938 after deducting Government contributions	118	−28	−44	−67	−227	21
Labor income, 1934	−41	−16	−120	−68	−303	−44
Change in labor income from 1934 to 1938	159	−12	76	1	76	65
Net increase for Soil Conservation Service cooperators	171	....	75	....	11	....

1934 to 1938 (table 4). As might be expected, the dairy farms made the greatest increase, probably because of their ability to utilize more advantageously the increased production of hay and pasture. Possible future adjustments between changed feed production and livestock may result in more equal advantages in labor income to the different types of farms.

Very little, if any, of the increase in income on cooperating farms from 1934 to 1938 can be attributed to saving the soil over such a short period of time; but it can be attributed primarily to the changes in land use and farm management practices on these farms. These farmers operated under the recommended soil conserving system and at the same time maintained their income after the program was established. Of much greater importance is the fact that the farm has been

SPECIAL ANNOUNCEMENT

The next issue of Soil Conservation tells of the plans, progress, and performance of soil conservation districts.

Farmers speak of the meaning of districts to themselves, their neighbors, their communities. Supervisors give the inside story of problems met, opportunities embraced. Financiers relate sound banking to sound districts.

Straight from the grass roots of a great farm movement comes this convincing assembly of experiences, ideas, methods, comments, charts, maps, and halftones. You'll want to read it from cover to cover.

—The Editor.

Panorama of delta of sediment deposited in Lake Raleigh from small tributary.

SOIL EROSION DAMAGES PUBLIC WATER SUPPLY

By ALEXIS N. GARIN [1]

SOIL Conservation Service workers have long recognized that soil erosion not only destroys farm and other lands but also causes severe damages to water-storage reservoirs and particularly to municipal water supplies. Numerous physical surveys have shown the extent of storage loss in reservoirs, but until recently no attempt has been made to appraise the physical damage from an economic standpoint. A study conducted jointly by the Soil Conservation Service and the North Carolina Agricultural Experiment Station, covering 28 municipalities, representing 90 percent of the water supply reservoirs in the State and 98 percent of those found in the Piedmont area, has determined that the costs resulting from losses of storage capacity are appreciable and that the additional costs of clarifying or desilting the water for domestic and industrial use also are significant.

The two items above mentioned (1) the financial burden placed on municipalities in terms of the expense for filtering or desilting the incoming water for public use, and (2) the burden placed upon the municipalities in terms of the depletion of the reservoir storage capacity of the municipal water supply systems, are discussed in some detail in this article.

Cost of Water Purification

An examination of filter plant and settling basin records shows that water carrying only a nominal supply of sediment requires less chemicals for purification than water that carries excessive quantities, especially of colloidal matter. A definite correlation exists between turbidity and the amount of alum, the principal coagulant used by most cities in water purification. The amount of alum used frequently varies more than 50 percent between maximum and minimum turbidity. An examination of individual municipal water plant records will reveal, however, that this relation exists only for the same type of water and that the amount of chemical used varies greatly from plant to plant even though the turbidity readings are of the same magnitude. Obviously there are other important factors which influence the amount of chemical needed in water purification, such as size and character of suspended particles, alkalinity, chemical composition, etc. The quality of any type of water varies from day to day and from season to season so that the relation between turbidity and chemicals for any single or even a small number of readings may not be clear, but when the readings from a large number of cases are combined the correlation is unmistakable.

In 1937 the total amount of water treated by the 22 Piedmont towns [2] which derive their water supply from reservoir sources was approximately 13.5 billion gallons; for the treatment $68,000 worth of chemicals, or an average of $5 per million gallons, was used. An estimated average reduction in the cost of chemicals of about $1.50 per million gallons of water treated can be expected if or when partial erosion control practices comparable to those employed in the High Point, Greensboro, Burlington, and other soil conservation demonstration areas are adopted on all the 22 watersheds. On the basis of the 1937 water use, this would amount to an annual saving of $20,000.

[1] Project supervisor, division of economic research, Soil Conservation Service, Washington, D. C.

[2] Data from only 22 of the 28 municipalities were used in the final calculations because information from the remaining 6 municipalities was incomplete in some respects.

Opinions of water supply engineers, water plant superintendents, and other qualified persons indicate that erosion control measures on the watersheds would result in substantially lower operating costs. Some of the factors involved are greater uniformity of raw water with smaller capital outlay for settling basins and for filter plant units, and lower power, labor, and other costs for backwashing filters and flushing or cleaning the settling basins. It is estimated that if the average proportion of suspended matter at the intakes can be decreased 25 to 30 percent, an average reduction in cost of treatment of approximately $7 per million gallons of water can be expected. On the basis of suspended load sampling, by the United States Geological Survey in cooperation with the Soil Conservation Service at the latter's High Point demonstration project, this is considered a conservative estimate of the effectiveness of changes in land use and application of erosion control measures in reducing the amount of sediment load in the streams. This means a reduction from $70 to $63 per million gallons in the cost of finished water at the filter plant. Hence, a total annual saving of approximately $94,500 for the Piedmont group of towns, not including reduced silting damages to reservoirs, seems probable.

Sedimentation in Reservoirs

The 22 watersheds of the public water supply reservoirs in the Piedmont area comprise a total area of approximately 504,000 acres valued at $10,900,000 on which buildings worth $6,000,000 have been constructed, making a total valuation of $16,900,000 for both land and buildings (U. S. census). For the same 22 cities and towns the total developed storage in reservoirs used primarily for water supply is approximately 36,000 acre-feet. As distinguished from the foregoing primary use, most of these reservoirs have important recreational and scenic values as well, and one, Lake Michie of Durham, is used also for power purposes. No satisfactory practical means of allocating storage capacities needed for different uses are available, and each reservoir must therefore be treated as a composite unit supplying services of several kinds. Their combined original cost is estimated at approximately $8,000,000, an average of $220 per acre-foot of storage, including accessories such as pipe lines, pumping equipment and similar necessary items to make the storage available for use. If the accessories are excluded, the average cost is approximately $5,000,000 or $134 per acre-foot.

The average annual depletion of aggregate storage capacity through sedimentation is approximately 0.65 percent of the total original capacity and the annual loss of capital value in storage facilities amounts to about $32,000, not including accessories. Soil erosion control measures are not expected to eliminate all of this annual loss in an agricultural area such as the Piedmont. A certain quantity of sediment will always be present in flood water so long as the land is used for agricultural purposes, and no economical means of avoiding the ultimate filling up of reservoirs from this cause is at present known to engineers and others. The feasibility of greatly reducing the existing rates of depletion has been demonstrated at High Point and is used as a basis for the following computations.

Erosion Control at High Point

The High Point Reservoir was surveyed by the United States Geological Survey in cooperation with the Soil Conservation Service prior to the inauguration of the soil conservation program on its watershed in 1934. At that time the reservoir was 6½ years old. This survey showed an average annual loss of capacity of 0.77 percent.

In the spring of 1938 a second sedimentation survey of the reservoir was made by the sedimentation division of the Soil Conservation Service. During the intervening period of 3¾ years, 39 percent of the total drainage area had been placed under cooperative agreement and the establishment of soil conservation practices, with reorganization of land use, had been completed on nearly all of the farms involved.

The second survey showed that the average annual rate of silting had dropped from 0.77 percent during the first 6½ years of the reservoir's life to 0.59 percent during the succeeding 3¾ years.

The United States Geological Survey in cooperation with the Soil Conservation Service maintains first-class stream gaging stations above the heads of backwater on each of the main tributaries of Deep River leading into High Point Reservoir. A large number of discharge measurements have been made at these stations since the soil conservation demonstration project was established in 1934. Systematic sampling of the suspended load of the streams has been carried on also at these stations since that time. The results show a decrease of about 25 percent in the average amount of suspended sediment in the floodwater. This is true whether based on monthly and yearly averages or on individual storms of approximately the same intensity and duration.

At the old rate of silting, a total of 1,685 acre-feet of storage capacity would have been lost by the time the original excess reservoir storage for water supply pur-

poses became depleted. By that time, i. e., in 1985, a period of 50 years beginning with 1935, the capacity of the reservoir would have been reduced to the point of maximum service demands of the city. During this period an average capital value of $5,224 would have been lost each year,[3] while at the new rate of silting the annual loss of capital value is only $3,984.[4]

The annual benefit of the present erosion control program to the city is therefore the difference between the annual sediment damage with and without watershed treatment, or $1,240. In many of the smaller watersheds at least, an even more effective control program should be feasible if the combined town and farm interests adversely affected by the accelerated rate of erosion are included in a consideration of the costs and benefits of its control. The High Point program has been worked out primarily on the basis of agricultural interests of the watershed, and only 39 percent of the land has received some sort of treatment. The percentage of control of the most critical sediment-producing areas such as severely gullied areas, roads, and streambanks, is even smaller. Moreover, the effects of such control practices as planting of trees, the treatment of badly eroded hillsides, etc., will not become substantial until after a considerable lapse of time. Consequently the sustained long-time beneficial effect of the program should become still more pronounced in the future.

[3] Original capacity of 4,354 acre-feet×0.77%=33.7 acre-feet per year; 33.7 acre-feet×@$155=$5,224 per year.

[4] Capacity of 4,354 acre-feet×0.59%=25.7 acre-feet per year; 25.7 acre-feet×@ $155=$3,984 per year.

Conclusions

The 22 reservoir drainage areas constitute, generally speaking, compact problem areas where erosion causes appreciable damage to public water systems and where the general benefits of improved land use can be immediate and real. In view of the large economic losses to the public resulting from sediment-producing erosion, it is apparent that these public costs, as well as the economic losses to individual farms, should be assessed against soil erosion and should be considered in the question of "costs and benefits" of its control. In most watersheds it would seem to be sound economics to control erosion on critical areas of sediment production to a greater degree than the present agricultural interests can justify solely on the basis of protecting the value in the land itself. This is especially true because of the present financial limitations of the farming groups, regardless of the needs of the future. Also, in some of the watersheds. important sources of erosional debris are public highways, where correction must rest with the public.

Whereas, from the standpoint of land conservation alone, widespread upland erosion-control measures may not be justified over some parts of the watersheds and on some types of land, nevertheless when we consider the attendant decreased movement of upland soil particles, with consequent decreased available sediment load and corresponding benefits to downstream developments, a more general adoption of remedial measures becomes justified.

TREE SURVIVAL IN A HIGH PLAINS AREA

By CHARLES G. VAN GORDER [1]

WHEN the Dalhart demonstration project was established in the southeast portion of Dallam County, Tex., in 1934, the project technicians faced many obstacles to a satisfactory woodland program for this area. Very little information was available concerning tree planting in this section of the Panhandle. Past experience with plantings was discouraging because of the high mortality rate and farmers over the project area believed that trees could not be grown successfully because of the dry weather. Their many failures seemed to justify this belief. Native trees and shrubs occur only in scattered groups in certain localities along the canyons and intermittent streams. The most common species are the cottonwood, willow, hackberry, and western soapberry.

The evidence was that for trees and shrubs to thrive, it was necessary that they have moisture equivalent to 20 to 30 inches of rainfall annually. The average precipitation, however, is approximately 17.50 inches, as recorded over a 30-year period by the United States Dry Land Field Station near Dalhart. The solution seemed to be the accumulation or building up of additional soil moisture and utilizing run-off water in low spots. However, low places did not always occur where trees were most needed. In view of this difficulty, special sites, to which surplus water could be diverted from other locations, were developed be engineering structures.

In the spring of 1935, approximately 12,000 trees were set out on the project. Because the use of accu-

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Two-year-old trees on the Miles farm, after a rain in May 1937. The site was well engineered to hold plenty of field water.

mulated run-off water in growing trees and shrubs was a new practice, it was realized that data concerning survival under such conditions was needed. Especially was information required pertaining to the adaptation of species to the sites. Survival counts, begun in the fall of 1935, have been obtained for the past 5 years. Because of the small number of trees and shrubs in each planting (50 to 500) a complete check of all trees was made to determine survival.

The survival count was made each year in September and October. The percentage of survival for each planting was recorded, as well as the total number of trees and shrubs, alive and dead, of each species on the site.

Table 1 shows the honey locust to be the hardiest and perhaps the best adapted of all the tree species planted on the project. It makes a rapid growth. There are objections to the many thorns on the honey locust, but observations indicate that the thornless variety is equally as hardy. The osage orange, although drought resistant, makes a rather slow growth. This species deserves wider use in windbreak plantings. The desert willow appears to thrive under dry con-

TABLE 1.—*Survival record of tree planiings*

Species	Total planted 1935	Number living 1939	Percentage of survival
			Percent
Honey locust (*Gleditsia triacanthos*)	3, 807	3, 258	86
Osage orange (*Toxylon pomiferum*)	209	173	83
Desert willow (*Chilopsis linearis*)	2, 097	1, 711	82
Chinese elm (*Ulmus pumila*)	1, 488	1, 129	76
Jujube (*Zizyphus jujuba*)	133	99	74
Green ash (*Fraxinus p. lanceolata*)	1, 617	1, 178	73
Cottonwood (*Populus sp.*)	673	451	67
Russian mulberry (*Morus alba*)	1, 868	1, 200	64
Black willow (*Salix nigra*)	271	155	57

Enjoying the shade of trees planted by the Soil Conservation Service on farm of W. H. Miles, demonstration project cooperator.

ditions better than any of the other species. It is very desirable for single row windbreaks. It also has a definite place when used as the outside row of a large planting. It produces an abundance of trumpet-like flowers during the last half of summer. The flowers are about 2 inches long, lilac in color with two yellow stripes inside. The desert willow often makes a growth from 3 to 5 feet in a summer. It suffers some frost damage.

The Chinese elm, 10 percent below that of the honey locust in survival, has made an excellent showing. No other tree in Dalhart has been so extensively planted. It is drought resistant, fast growing, and is immune from attack by the red spider, a serious problem with the American elms.

The few seedling jujube trees planted on the project proved to be very satisfactory. The jujube is drought resistant, thrives under limited moisture conditions, is a unique tree in that the short limbs droop and the branches grow in a zig-zag fashion resembling canes of the grapevine. The leaves are of a glossy, dark-green color. The fruit of the jujube is russet in color and about the size of a small olive. It is a highly desirable wildlife tree. Improved varieties produce fruit about the size of a walnut, which, when preserved in syrup, are similar in taste to the date.

The green ash trees have done well where surplus water was available. The ash grows slowly but is highly desirable for use in mixed plantings. This species enters the dormant period early in the fall and consequently escapes frost damage.

No other tree on the project has made as rapid growth as the cottonwood. Many specimens are over 20 feet in height, with trunk diameters of 5 inches. The cottonwood appears to have a shallow root system and will not tolerate an excessively dry or wet location. The large tobacco worm has completely defoliated the cottonwoods on certain sites where no cultivation was practiced.

Survival of the Russian mulberry is low compared with the other species. This tree responds to additional water and cultivation and makes a rapid growth. Under dry conditions, the mulberry appears to be more or less stunted. It suffers some winter injury every year, and when the grasshoppers are serious, they defoliate the trees. The black willow is recommended primarily for use in excessively wet locations, such as the playa lakes. It spreads rapidly by sending up numerous sprouts around the original plant.

Many miscellaneous species have been planted for experimental purposes, but the majority of them gave poor results. In some instances the poor condition of the planting stock, and the location of the species within the site, undoubtedly had something to do with their failure.

TABLE 2.—*Survival record of different types of plantings*

Types of plantings	Number of plantations	Total planted, 1935	Percentage of survival
			Percent
Group plantings with engineering structures	4	1,653	89
Roadside plantings (natural water-level sites)	36	3,744	86
Roadside plantings with engineering structures	14	3,070	84
Farmstead plantings with engineering structures	12	2,082	71
Farmstead plantings without engineering structures	8	1,614	45

A study of table 2 shows that group plantings, where engineering structures are used, have the highest survival. Roadside plantings, however, are very satisfactory. The natural water level sites are somewhat better than the roadside plantings which required the use of structures, while the farmstead windbreaks had a lower survival. General observations indicate that the greatest amount of growth was made by trees located where natural depressions occurred, and where run-off water accumulated. The trees did well on engineered sites where the structures were properly maintained, and where the trees were cultivated to keep down weed growth. If the engineered sites were neglected, and weeds and sand allowed to accumulate, the sites lost much of their effective water-storage capacity. On the basis of 5 years of experience with tree planting in the Dalhart area, the following conclusions seem warranted:

1. Tree sites should be located either in natural depressions where run-off water accumulates, or on other locations where engineering structures make possible the diversion of water from roads and adjoining fields into the tree planting.

2. Trees should be planted in suitable locations and only by farmers sufficiently interested to care for them.

3. Plantings should be clean cultivated.

4. Trees should be pruned about the base to lessen weed and sand accumulations.

5. Protection against injury by rabbits should be practiced while the trees are small. Wire guards have proved more effective than rabbit repellants.

In the next issue of Soil Conservation: the better-than-fiction story of the Turkey Creek Soil Conservation District. A. E. McClymonds calls his article, "Of the Farmers, By the Farmers, and For the Farmers."

AGRONOMIC INSTRUCTION FOR MODERN AGRICULTURE

By IDE P. TROTTER [1]

EDUCATIONAL institutions long have been regarded as conservative, and agricultural colleges, while less conservative than others, were not completely above criticism in this regard. For years the study of soils and crops was regarded by many as relatively static and much agronomic instruction tended to look backward and emphasize the past more than the future. This seemed to work satisfactorily until about 10 years ago when something began to happen to agriculture along with all the rest of our economy.

To be sure, this something had been accumulating for a long time, but the storm broke about 1930. From the wreckage we gathered together the pieces and began reconstruction. Since the old plan had not worked to everyone's satisfaction, it was decided that agriculture should be rebuilt on a somewhat different plan. New organizations were set up to help chart the course and carry out the plans for a new agriculture. Thus came into being the Soil Conservation Service and the Agricultural Adjustment Administration, to mention only two of those agencies vitally affecting agriculture. These organizations began planning things for agriculture and employed people to operate the plans. They became action agencies. They took the information available in the United States Department of Agriculture and at the agricultural colleges and launched out on a new and unexplored course. People demanded that something be done about the agricultural problems; they wanted the new programs to be tried on a field scale involving whole farms, communities, and even very large watersheds. As a result the Department of Agriculture took on new responsibilities—it became an agricultural planning and action agency for the Federal Government and the cooperating States, whereas previously it had been concerned primarily with education, demonstration and research in agriculture. This new double responsibility for the planning of programs and putting them into use immediately called for men of action with up-to-the-minute training.

For three-quarters of a century the agricultural colleges have been charged with training leaders for agriculture. Those of us responsible for directing this training found suddenly that the change in the national agricultural program had brought with it a change in the type of training. We were faced with much wider opportunities and larger and more insistent problems. We realized that the opportunity depends on the ability of educational institutions to keep abreast of the rising tempo of planning and action programs. Old courses had to be reoriented and new ones built in order to prepare graduates for the new opportunities and responsibilities that would be incumbent upon them in accepting and holding employment with the action agencies, and also to provide men with the new action viewpoint for the older agencies. We knew that we must all understand this viewpoint and help to develop it along the soundest possible lines.

The problem today is this: How can the agricultural colleges meet the requirements of the most recent action programs? The educational problems involved, and the approach that can be made to them, are particularly difficult in view of the fact that in many instances actual field operations have stepped ahead of the research results on which a sound program must rest. This does not imply that research has lagged; rather, it means that the necessity for immediate application of ideas and measures in an operations program tends to expand more rapidly than scientific and dependable research data can be developed. As a result, many of the present action programs on the land have the peculiar nature of being both operations and research—at least to the extent that trial-and-error methods in the field have played an important part in the evolvement of some of the more recently accepted farm practices.

The action programs which have found it most necessary to expand their work into previously unexplored fields are, first, the conservation program and, second, its closely related ally, the land-use planning program. Their training problems and those of the older organizations cooperating with them will illustrate the difficulties encountered and the attempts that are being made toward solution. Our discussion therefore will deal primarily with them.

Administrators of these action agencies discovered very quickly that they not only had the problem of selecting men with suitable training from year to year but that a very large number of their older staff members were in need of new training with the action

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viewpoint in mind. This called for what has been termed "in-service training," which means that men from established professional positions attend agricultural colleges for short periods of intensive special training in line with their types of field work. It became obvious that many of these special courses should be under the direction of competent officials from the action agencies or staff members who have been in touch with the action program—this in order that the latest and most accurate information from the day-to-day developments of these national programs might be presented.

In attempting to discharge its obligations to the people of Texas in connection with the impact of these new ideas and new programs on the State's agriculture, the Agricultural and Mechanical College of Texas inaugurated a series of special courses by visiting professors during the summer session of 1940. The results achieved were sufficiently encouraging to make us believe that we have taken a long step toward meeting the needs of the action programs by furnishing to their workers a valuable yet flexible type of "in-service" training. For the benefit of action agencies and educational institutions, a brief sketch of the courses offered, and a somewhat more detailed description of one which we regard as most typical, is given in the following discussion.

The graduate courses included in the special series, and the men who taught them, were as follows:

Soil Classification and Mapping, E. A. Norton, chief, physical surveys division, Soil Conservation Service, Washington, D. C.

Range Management and Ecology, W. G. McGinnies, chief of range research, Southwestern Forest and Range Experiment Station, Tucson, Ariz.

The Fundamentals of Grass and Pasture Improvement, F. D. Keim, chairman, department of agronomy, University of Nebraska.

Forest Soils, R. F. Chandler, Jr., assistant professor of forest soils, Cornell University (6-weeks course).

Feeding of Farm Animals, F. B. Morrison, head, department of animal husbandry, Cornell University.

Animal Breeding, F. F. McKenzie, assistant professor of animal husbandry, University of Missouri.

With one exception, all of the six special graduate courses offered at the Agricultural and Mechanical College of Texas during the summer of 1940 were conducted over a period of only 3 weeks each; the course in forest soils ran for the customary 6-weeks summer term. The others were so arranged that one was being offered during each of the four 3-week periods constituting our two terms of summer school, and during only the first 3-week period were two such courses in operation. Thus, it became possible for both graduate students and professional workers to take one or more such courses as their interest indicated and their time permitted. Each course was arranged on such a full schedule that a student carried only the one course of his choice during the 3-weeks period. In this way, it was actually possible to give during the 3 weeks a course as complete or more complete than that of a regular 6-weeks summer term. The 3 semester hours of graduate credit given for each course were therefore fully earned.

Enrollment in the special short-course series reached a total of 152. In addition there were more than a dozen staff members who periodically visited the different courses. Readers of SOIL CONSERVATION will be especially interested to know that the course on soil classification and mapping, given by Mr. Norton, was one of the most popular. There was an enrollment of 40 in the class. The students came from 4 States and included 29 Soil Conservation Service employees, 6 vocational agricultural teachers, 1 graduate student, 1 Bureau of Agricultural Economics employee, and 3 undergraduates. Graduates from 20 colleges were represented in the class.

Two advantages of the short-period, intensive type of course should be pointed out. One is that it was possible to secure an outstanding authority in each field to give the different courses, whereas that probably would not have been possible for a 6-week or longer period. From the standpoint of extension workers, Farm Security Administration employees and others actively engaged in agricultural work, many could attend the 3-weeks courses in the time allowed for annual leave, but would not have been able to take time from their regular duties for a longer period of study.

A brief summary of the day's schedule and the organization of work that was followed in all of the classes will probably be of interest.

Each class opened daily at 7:30 a. m. The first hour to an hour-and-a-half was given over to a lecture on the subject at hand by the professor in charge. Following the lecture there was a discussion period that ran as long as the class members desired. These were lively, stimulating periods when every man had the opportunity to ask questions or otherwise "speak his piece." It is to be remembered that the men in each class were there primarily because of their particular interest in the subject matter and the instructor. The majority of them were mature and established professional workers who were using their vacation

time for professional improvement. Needless to say every member was determined to get all that he possibly could out of both the lectures and the discussions. Because of this healthy attitude many of the classes broke up only when the call came for lunch.

Afternoon sessions started at 1:30 p. m., and were given over to practical application of the special subjects. Some classes held afternoon field trips, others engaged in laboratory practice—in short, each class carried into actual practice the subjects that had been taken up in the morning sessions. For instance, members of Mr. Norton's class spent much time in the field, where they studied soils and their classifications, investigated erosion conditions, mapped physical land factors, and made land-use capability maps. In the evenings the entire enrollment of the special course series, together with faculty, extension and experiment station staff members, occasionally gathered to hear lectures by outside authorities in different agricultural fields, or by the specialists who were teaching some of the scheduled courses. More often than not, the undergraduates, graduates, and professional workers carried their discussions far into the night upon returning to the dormitories after the evening meetings.

During two week ends, most of the classes made field trips to different parts of Texas to make first-hand studies in connection with their courses. These 2- to 4-day field trips were high lights of the courses, as they afforded an opportunity for laboratory studies on a large-scale basis under the varying soil and ecological conditions found near College Station. The week-end field trips made by Mr. Norton's class covered nearly a thousand miles. On the first trip the class traveled 450 miles to a southwest area where the soils of a number of physiographic regions might be studied and classified. The second week end took them more than 600 miles through eastern Texas where at least a dozen sharply contrasting soils typical of the humid South were inspected. Short afternoon field trips near the Agricultural and Mechanical College of Texas added some 200 miles, making a total of more than 1,250 miles of travel connected with the course in soil classification and mapping. The three other courses in the agronomic group added about 2,000 additional miles of field travel and study. Twelve hundred more miles represents travel of the four instructors in preparing for class trips.

Only after the close of this extensive series of summer graduate courses was it possible for us to appraise their value objectively. The values turned out to be so much more vital and extensive than we had anticipated that we believe it worth while to outline a few of them for the readers of the magazine of the Soil Conservation Service. They may be dealt with under four heads: (1) Advantages to the students, (2) to the instructor, (3) to the colleges, and (4) to the profession.

The students indicated that these courses gave them more valuable and flexible courses than had previously been available. To the full-time graduate student came new and practical viewpoints in his chosen field of work, in the classroom and on the field trips, from the visiting professor and from his more experienced associates. The established professional worker who came to take these courses was given the opportunity of keeping abreast of the latest development in his field, both in action programs and at the colleges. He could compare notes from his own experiences with those of his associates in the course who came from many States and many lines of work.

As to the instructor, the courses provided him with the opportunity of visiting and becoming acquainted with a new section of the country, a new group of students and professional workers, and another agricultural college. He also profited in that he was required to organize and present his special information, and to observe the reactions of many men from many places as to its value to them and their sections of the country.

It was not alone the student and the instructor who benefited from the series. Tremendous advantages accrued to the benefit of the Agricultural and Mechanical College of Texas as sponsor of the courses. The special series of courses helped to maintain the college as a center of agricultural education and gave the college staff an opportunity to become better acquainted with other institutions and the action agricultural programs represented by the instructors and the professional men. In general the series aided the educational program by bringing courses up-to-date with the action developments in different fields; men from different colleges, coming together for study in specially selected subjects, helped to renew the spirit of cooperation and understanding among the various institutions represented. We feel sure that the men from different bureaus and agricultural agencies, as well as the college people, profited through the courses by getting down to "brass tack" discussions of their programs and problems, unhampered by office routine—telephones, agency and college regulations, and taboos. We hope that we can include these special courses as a regular feature of our future summer school sessions.

LESPEDEZA SERICEA FOR ROAD CUTS AND FILLS

BY VERNE E. DAVISON [1]

HIGHWAYS, including State and Federal roads, constitute a sizable subject for erosion control. The present primary systems in Virginia, North Carolina, and South Carolina cover approximately 9,377, 11,231, and 8,530 miles, respectively. The problem extends also to the secondary roads, about four times the mileage of primary roads. Today these three States have under State or county supervision, in the order as named, approximately 45,734, 58,332, and 43,530 miles, of both primary and secondary roads. This is a total of 147,596 miles, or the equivalent of about six times the circumference of the earth.

While considerable attention is being given to the control of erosion on primary road systems of the several States of the Southeast, much of the vegetative treatment is unsuccessful because the plants being used are not suitable for the conditions. It is reasonable to suppose that the control of highway erosion on secondary or farm-to-market roads will await more practical and less expensive measures than those now used on primary systems.

Lespedeza sericea, a deep-rooted perennial legume, has proved its adaptability to meet many requirements of highway erosion control and related maintenance problems in Virginia, North Carolina, South Carolina, Georgia, Alabama, and Mississippi and is probably satisfactory for parts of Tennessee, Kentucky, West Virginia, Missouri, Arkansas, and Louisiana.

During frequent travels over these and other States, I have observed that the same erosion problems occur over and over again on shoulders, forward slopes, side ditches, fills, back slopes, and above the crown of the cuts. There is a vegetative treatment suitable for each of these conditions.

Before discussing the conditions under which *Lespedeza sericea* is probably the best erosion control plant to use, it may be well to eliminate those wherein its establishment and maintenance would not be particularly desirable. The shoulder, the forward slope of the ditch, and the side ditch itself, present a set of growing conditions quite similar to those of pasture; therefore, a pasture grass, an annual legume, or a mixture of grasses and annual legumes is adaptable and should be maintained in the same manner as is considered best for pasture improvement. The side ditches adjacent to the road present special problems for which Bermuda grass is excellent because it and other such plants are capable of withstanding large volumes of concentrated flow. Thus, by process of elimination we arrive at the conclusion that for highway erosion control *Lespedeza sericea* probably is more desirable than other adaptable plants for use on (1) the back slope of cuts, (2) steep sides of fills, and (3) borders for cultivated land.

Attention should be given first to the back slope of cuts. Here the exposed subsoils, uncovered by the road cut or drain ditch, require a deep-rooted perennial, as the site is very dry and plant foods are more thinly disseminated than in topsoils. The use of annual lespedezas, Bermuda grass, or other shallow-rooted plants is usually unsuccessful, except temporarily, because sufficient plant food and moisture are not within reach of the roots. Erosion progresses even when topsoil is applied, as there are periods of the year when such plants do not give sufficient protection for steep slopes. To delay the establishment of permanent vegetation is but to double the cost of treatment and to lengthen the period of maintenance. Silt, washing down from the cut, frequently fills up the adjacent drainage channel and is then dispersed on to the road. The deposition must then be removed by hand or maintenance machinery, and this is an operation that is likely to destroy the vegetation which was adequately protecting the shoulder, slope, and ditch before the foreign deposition accumulated.

A second highway site for which this legume is suitable is the steep side of a fill where vegetation requiring a minimum of maintenance is desirable.

L. sericea has been found valuable for planting strips 15 or more feet wide bordering cultivated land. Drainage from crop rows and terrace outlets necessitates construction of small channels above the crown of the cut slope and such channels serve as turn rows for farm machinery. Bermuda grass is frequently used in the channels, but most farmers object to it because the runners may be caught by the plow and released elsewhere in the field.

For the past 5 years *L. sericea* has been used in Soil Conservation Service erosion control demonstrations in the Southeast, for gully control and for field borders. While usually the principal objective was rehabilita-

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Lespedeza sericea provides adequate soil protection for steep banks.

tion of areas for wildlife the conditions were comparable to those encountered in highway protection. Since direct economic returns from wildlife have been relatively small, it has been necessary to reduce expenditure of labor and materials to a minimum consistent with dependability. With this in view, improved methods have been progressively developed, proved, and applied. Road cut or back slope conditions are almost identical with those found on the sloping sides of gullies; the fills are not unlike many field borders on the lower side of sloping cultivated land; and the spread of Bermuda from highway rights-of-way into adjacent cropland is no different from its spread from pasture and terrace outlets. Thus it is gratifying to know that since 1938—in three successive growing seasons—the establishment of *L. sericea* has been demonstrated successfully on highway back slopes, highway fills, and as buffers between Bermuda and cropland.

L. sericea may be established merely by broadcasting scarified seed on well-prepared seedbeds soon after the last killing frost in the spring. The seed should be sown at the rate of 30 pounds per acre, on top of the ground without covering. A moderate application of fertilizer, especially phosphate, is advisable, although the amount should be increased for subsoil conditions. On very acid soils, a little lime will help establish the young plants. No further fertilizing is necessary unless a light green color appears to indicate that the original application was insufficient.

Seeding of *L. sericea* on back-slope subsoils and on the sides of fills always should be preceded or accompanied by the application of mulch. The plant can be established with mulch on slopes of 1½ to 1 percent. Pine branches applied any time after midsummer, in preparation for spring seeding, will protect the soil against washing, eliminate hand preparation of the seedbed, and ultimately assure an adequate stand of *L. sericea*. Scarified seed should be sown through the mulch immediately after a rain the following spring. Submoisture is important to carry the young plants through short periods of drought during the first season. An excellent submoisture condition is assured by the increased infiltration and the reduced evaporation resulting from mulch applied in late summer, fall, or early winter. It is usually unnecessary to stake down the mulch, even on steep slopes.

Grain or hay straw may be substituted for pine limbs on moderately sloping cuts and on fills, and usually it is more readily available. Any mulch may be applied at seeding time. *L. sericea* stems are quite satisfactory as a combined mulch and seeding agent if they are cut and applied as soon as the seed is ripe—about the first frost date in the fall. Thus seeding is automatically accomplished with mulching. Most of the scarified seeds do not germinate until spring. An illustrated leaflet,[2] "Mulching to Establish Vegetation on Eroded Areas of the Southeast," gives full directions concerning mulching materials, their application and usefulness.

Once established, *L. sericea* requires little if any

[2] Leaflet No. 190, U. S. Department of Agriculture, Washington, D. C.

maintenance for years. An early spring mowing, however, would add to the beauty of the site, as the brown stems of the previous year's growth would thus be hidden by the new green shoots which quickly appear after the last killing frost. Mowing at this time of the year does not alter the permanency of *L. sericea;* however, the stems should not be removed—the ton or more of mulch naturally provided by leaves and stems greatly increases the value of the cover for erosion control. Likewise, to prevent Bermuda grass from spreading, the *L. sericea* should not be cut except just before the growing season when Bermuda is practically dormant. The tall, vigorous *L. sericea*, if uncut, shades out the Bermuda, whereas mowing during the growing season would only encourage the grass as it does in pasture management.

For road cuts that are either too rocky or too steep to be mulched and seeded to *L. sericea*, a vine such as kudzu or honeysuckle is needed.

A few common mistakes in highway erosion-control measures deserve mention. As stated earlier, shallow-rooted perennial grasses and annuals that must reseed are seldom successful on severely eroded sites or where back sloping exposes the subsoil. Grass-and-legume mixtures will not prevent the succession of shrubs and trees unless there is frequent maintenance, and *L. sericea* will not attain a satisfactory stand from such a mixture. Where grasses are wanted, this legume should be left out of the mixture. At one time a mixture of 20 percent *L. sericea* with equal or greater amounts of annual lespedezas and grasses was thought promising where erosion control was the only objective, but it has been definitely determined that annual lespedezas are serious competitors with *L. sericea* and the mixture is therefore not recommended. This point may be summed up by saying, plant *L. sericea* alone or not at all.

A mulch of brush, hay, or grain straw should never be applied without the seeding of permanent vegetation to replace the temporary soil covering. Natural vegetation is seldom of the kinds desired and even frequently fails to become established. A mulch so heavy that seedlings are smothered is to be avoided.

Many kinds of shrubs have been planted on roadside cuts, but very few grow to maturity. In such instances the control of erosion usually is dependent upon scattered weeds and grasses that accidentally catch with the shrubs and provide some ground cover.

The control of highway erosion aids in reducing the silt from running streams—a biological necessity for the reclamation of game fish habitat. Highway contributions of silt, though much less important than the aggregate from farm lands, is worth consideration. *L. sericea* may or may not be of additional benefit to upland wildlife as food and cover along highways, but that is relatively unimportant in this discussion.

The chief disadvantage in using this legume is that it requires 2 or 3 years to provide complete protection, and often it appears to have failed in the first year. No perennial of long life will attain maturity more quickly, however, and the temporary mulch used in its establishment gives satisfactory soil protection until it is replaced by *L. Sericea*. Annual weeds and grasses may seem to choke the young plants the first year; but they will make surprising growth the second year. Clipping the annual weeds and grasses is not advisable.

In summary then, *Lespedeza sericea* is recommended because (1) it is adaptable to a wide variety of severe conditions; (2) it vigorously prevents the encroachment of shrubs and trees and greatly reduces maintenance; (3) it will not spread into cultivated fields or to the shoulders of highways; (4) it is attractive in appearance even without frequent mowing; (5) and it provides continuous living protection to the soil from early spring, through summer, to frost, and an equally effective cover by its dead leaf mulch through winter and early spring.

RANGE UTILIZATION

SOME very significant results of experiments in the utilization of range forage were revealed at the Grassland Conference held at Amarillo, Tex., on September 5 and 6 to discuss grass problems for five Southern Plains States (Texas, New Mexico, Oklahoma, Kansas, and Colorado). This meeting was one of five regional conferences held throughout the United States to study grass—the feeding value of many grass species; their adaptability for various uses; methods of promoting grass growth; means of conserving pastures and ranges for most efficient use.

Comparing income from two range areas of the same size, the first stocked with 1,400 head of cattle and the other with 1,900 head, it was reported that the average income over 22 years was $6,000 more per year in favor of the area stocked with 1,400 head. On the latter range, the steers and sometimes the heifer calves not needed for replacement were kept to graze the extra grass in years of ample rainfall. In other words, the young stock was kept long enough to determine whether or not there would be feed for them, and, if not, they were sold.

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A FOREWORD TO THIS ISSUE

By the

SECRETARY OF AGRICULTURE

ONE of the most heartening developments in the national war against soil waste is the growing interest in conservation among the rank and file of people on the land. Call it a conservation "philosophy" or "tradition" or whatever you will, it is something this country has not had in the past but must have in the future if we are to be prosperous and secure. It represents a definite break with the exploitive tradition of the American people, which grew up when land resources seemed as inexhaustible as air, and when pressure of a rapidly growing population stimulated us to skim the richest productivity from our lands and forests—and then move on.

The timely growth of a philosophy of conservation and good land use among farmers is of first importance. Without it we cannot hope to win our battle against run-off, erosion, and land abuse. Each of the nearly 7 million farmers on the land must do his share of the conservation job if it is to be done.

Behind much of the increased initiative in soil conservation shown by farmers is the growth of soil conservation districts. The districts are organized by farmers by petition and referendum, are managed by farmers, are operated on a truly democratic basis, and are capable of stimulating the maximum action toward good land use by farmers themselves. The districts are proving to be a logical point of contact between individual farmers and many services from their State and national governments; they provide a much-needed mechanism to apportion the responsibilities of conservation between individual farmers and the community generally.

Within the past 4 years, 38 States have adopted laws enabling the establishment of soil conservation districts. Four hundred and thirty-five districts, covering more than 271,000,000 acres, have been established in these 38 States. The Soil Conservation Service has been the spearhead of the Department of Agriculture in working with districts, in establishing the basis for cooperation through memoranda of understanding, and in furnishing technical guidance, labor, materials, equipment, and other assistance. At the close of the past year, the Service was extending such aid to 307 districts, covering 186,000,000 acres in 36 States.

However, as the districts movement has grown, it has become apparent that the interests of the Department are not limited to cooperation with them through the Soil Conservation Service alone. Good land use is a goal sought by the Department of Agriculture as a whole. It is a common denominator of many phases of the national farm program. Many agencies of the Department are making contributions that aid districts in achieving this objective. Therefore, in September of 1940, new principles for departmental cooperation with soil conservation districts were issued, providing that the Department would enter into over-all agreements with districts, thus establishing a general basis for cooperation. Following this, as any agency of the Department becomes prepared to cooperate with a district, it may enter into a specific supplemental agreement.

The Department constantly is exploring the possibilities of additional cooperation with soil conservation districts. State agencies are doing the same. The outlook is promising. Already many agencies of the Department have found the district to be an effective meeting ground, where they may deal with representatives of farmers who are empowered by the will of the majority to initiate and follow through for better land use over a naturally bounded area.

Claude R. Wickard, Secretary of Agriculture, in his own Indiana corn field.

HERE AND THERE AMONG THE DISTRICTS

For many soil conservation districts throughout the country the State soil conservation committees and district supervisors have found it advantageous to appoint or designate key farmers in communities or neighborhoods within districts to take the leadership in helping the supervisors to carry on the affairs of a district. Such farmers are called *assistant supervisors;* in some cases, *community* or *neighborhood leaders;* in others, *local committeemen;* in a few instances, *group supervisors* as in Arkansas; and, *agents of the State soil conservation committee* in Alabama where they are so designated under the provisions of the soil conservation districts law.

In 1939 the supervisors of the Price River Soil Conservation District, Price, Utah, received many requests for help in eliminating beaver damage along irrigation canals. In the autumn the beavers were trapped cautiously and tenderly; then they were transported to upper watersheds where they built dams and homes unmolested.

Result: Farmers along irrigation canals are pleased. Stockmen in upper watersheds are pleased, because more water is stored there for livestock. The supervisors of the district received no complaints about beaver damage in 1940. The district did all this in cooperation with the Utah State Fish and Game Department.

The supervisors of the Central Alabama Soil Conservation District, the county agent of Autauga County, Soil Conservation Service technicians, the local businessmen and civic clubs of Prattville are cooperating in concentrating their efforts toward the control of erosion on a small watershed above the town. Complete conservation is their aim, and by applying complete farm conservation plans on every farm they may expect to attain their objective. Flood damage is a problem of the farmers and townsfolk alike; they are working together to control it by checking erosion. Community interest had to be developed and community action taken. Today, timber protection and fire-control work, as well as other conservation measures, are being undertaken on a neighborhood basis. The need for planting stock to establish sufficient thick-growing vegetation (principally kudzu) was a problem—the supervisors, with the help of cooperating agencies and individuals, are now establishing a district nursery.

Green Crowley Ridge Soil Conservation District in Arkansas has a community work execution plan for that part of the district in which C. C. C. labor is being used. Local leaders arrange for meetings to outline work for a 10-work-day period; a representative of the C. C. C. camp attends and lists the jobs the cooperating farmers are ready to start. All of the C. C. C. enrollees (two crews), with one foreman, are then assigned to this community while the other foreman attends another such meeting and outlines work for the following work period. To be eligible for work during a period the farmer must either attend the meeting, send a representative, or send word by a neighbor stating the work he expects to do.

The supervisors of the Cedar Soil Conservation District in North Dakota have worked out leasing arrangements, with State and county land administering agencies, that permit the district to make necessary land allotments to ranchers within the district. Under the plan, sizes of units are adjusted to provide for conservation and good land use, with adequate operating scope. The district also has enacted ordinances restricting the use of grazing lands to sound conservation and ranching practices. It is thought that with this cooperative program together with range conditions, water supplies, and feed reserves as developed in the district, some measure of permanency can be expected for the agriculture of the area.

One district cooperator in the Tallahatchie River District of north Mississippi has found a new and perhaps unique argument for the use of crop rotations in that area. He reports that on large farms with several tenants if a good rotation is followed all the crops in the rotation may be put in one field near the tenant's home, thus facilitating cultural operations carried on by the tenant. In the old method of cropping, the different crops in a rotation such as corn cotton, grain, and lespedeza were scattered over the entire farm, and tenants were compelled to travel considerable distances to and from fields while carrying on their farm operations. We now have a new and sound argument for the use of good crop rotations in strips for large farms in the Southeast where the farms are operated by several tenants.